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Abstract

This paper develops and validates a measure of "need for precision" which is defined as a proclivity or preference toward engaging in a relatively fine-grained mode of processing. An understanding of this construct is argued to be of importance in that it may be causally related to constructs in several areas of research including categorizing behavior and attitude and ability in quantitative domains. The measure of need for precision is tested for internal consistency, unidimensionality, and validity across several studies. Several interesting relationships of need for precision with constructs relating to categorizing behavior as well as to other constructs involving the use of precise information such as numerical information are found.

Individual Differences in "Need For Precision"

The aim of this paper is to develop and validate a measure of individual differences in 'need for precision' and study its relationship to other constructs. Need for precision is defined as a tendency to engage in a relatively fine-grained or precise (as opposed to a coarse-grained) mode of processing. This construct defines a cognitive style that reflects a proclivity toward making fine-grained or precise (as opposed to coarse-grained or imprecise) distinctions at perceptual and conceptual levels of processing. An understanding of this construct is important in that it may be causally related to constructs in several areas of research including categorizing behavior (which would be impacted by the fine-grainedness of distinctions made in forming categories) and attitude and ability in quantitative domains (because these domains involve the use of numerical information, which typically requires processing of a fine-grained or precise mode). While research in the area of categorizing behavior has focused on outcomes of categorization such as conceptual category breadth, researchers have pointed out the importance of studying antecedents of category breadth (Block, Buss, Blocke, & Gjerde, 1981). One suggested antecedent that has been suggested in past research is a style that focuses on fine-grained perceptual/conceptual distinctions (Block et al., 1981). This paper defines the construct 'need for precision' which captures such a style and develops and validates a scale for measuring individual differences along this construct. Further, the relationship between this construct and several other constructs are studied here.

Review of Relevant Literature

A review of past research on categorizing behavior provides a rationale for studying the construct, need for precision. The importance of this construct with respect to areas of research such as quantitative domains will also be briefly summarized. Categorizing behavior is important

to study in light of the pervasive use of categorization as a means of structuring the environment. Bruner and Tajfel (1961) define breadth of category as "the range of stimuli that are placed in the same class or category and share a common label" (p. 231). Block et. al. (1981) list several approaches that have been adopted to measure category breadth and point out that these approaches can be distinguished in terms of two types of tasks. One type of task is where subjects are provided with a particular exemplar and are required to estimate the boundaries to the category in question on the basis of a specified dimension (for example, the Pettigrew (1958) scale of category width which requires subjects to choose from several options to establish boundaries or ranges around an exemplar such as the average rainfall for a particular city). Depending on the width of the boundaries set for the category, subjects are identified on a continuum of breadth of categorization. The second type of task involves a set of objects that subjects are required to sort into categories either with or without the specification of a dimension on which the sorting is to be done. Variables such as the number of sorted categories and breadth of categories employed by subjects are used to understand categorizing behavior. The number of categories employed is used as a measure of conceptual differentiation (Gardner and Schoen, 1962) and is argued to be negatively related to the breadth of the categories employed (Block et al., 1981). Kogan (1976) refers to the first type of task as a bandwith task and the second type as an object sorting task.

Several researchers have studied the relationship of breadth of categorization with other variables. Bruner and Tajfel (1961), using a task where a category was specified and the number of instances that were reported by subjects as belonging to that category was identified as a measure of breadth of categorization, argued and found that narrow categorizers may be more sensitive to changes in the environment than broad categorizers. Narrow categorizers were argued to broaden and narrow ranges based on stimulus variation to a greater extent when compared to broad categorizers, the implication being that narrow categorizers may be more averse to risk.

Block et al. (1981), using four tasks to measure breadth of categorization, argued and

found that broad when compared to narrow categorizers (among pre-school children), would possess a "permeable perceptualizing apparatus," (p. 771) as indicated by tendencies to be influenced by the environment rather than internal constraints. The authors found support for a link between breadth of categorization and degree of perceptualization based on an analysis of personality correlates and outcomes of categorization tasks. The authors point out that an antecedent to that may explain their findings about breadth of categorization is "the failure to make fine-grained perceptual/conceptual distinctions among objects with minimal featural differences because of looser standards employed for assessing similarity or because of a style that minimizes such differences" (p.778). Another antecedent of breadth of categorization suggested in past literature is the use of higher level conceptual links in making similarity judgments (Saltz and Sigel (1967). Block et al. (1981) also found that gender is significantly related to category breadth with females being narrow categorizers when compared to males. Further, broad categorizers tended to score lower on IQ tests.

As mentioned earlier, Pettigrew (1958) developed a category width scale which provided the average value of some category and required respondents to choose from sets of alternatives to indicate the largest and smallest instance of that category. Pettigrew found that this scale was related to gender (females generally used narrower categories), quantitative ability (narrow categorizers had higher quantitative ability), and Rokeach's (1951) narrow-mindedness task (wherein comprehensive categories tended to score higher (i.e., broader category width) on the Pettigrew scale). A significant relationship was not found with the dogmatism scale (Rokeach, 1956).

Since the development of this scale, several attempts have been made to relate it to other constructs. Taylor and Levitt (1967) argued that narrow categorizers, being more sensitive to change than broad categorizers as suggested by Bruner and Tajfel (1961), would be less inclined to seek variety in experiences. Taylor and Levitt (1967) argued that "since change is merely

variability experienced sequentially", narrow categorizers would "tend to seek less variety in their personal experience than broad categorizers" (p. 349). They found partial support for this hypothesis using the Pettigrew scale and the sensation seeking scale (Zuckerman, Kolin, Price, & Zoob, 1964) with a significant positive correlation between the two scales being obtained for males and a non-significant positive correlation for females. However, another study that examined this relationship using the same measures (Farley, Peterson, & Whalen (1974)) did not find a linear relationship between the two variables but found a trend toward an inverted U relationship, with moderate categorizers scoring highest on the sensation seeking scale. Hence, a significant linear relationship between category width and sensation seeking has not been consistently found in previous research. More recently, Walker and Gibbins (1989) argued and found that broad categorizers (on the basis of the Pettigrew scale) tend to score higher on neophilia (defined as openness to novel information) because broad categorizers are more open to novel instances than narrow categorizers. Finley and Hachey (1988) argued and found a positive relationship between broad categorization and superior recall, since broad categorizers were argued to tend to group several items into a single category. In summary, several researchers point out that the determinants of category width have not be understood (Nosal, 1985; Walker and Gibbins, 1989).

Two points should be noted about measures of category breadth in terms of their nature and the differences between the tasks used to measure category breadth. First, the measures of overall category breadth, such as the category width scale and the sorting task, relate to outcomes of categorization, thereby requiring the isolation and study of causal antecedents of this construct. For example, the category width scale (Pettigrew, 1958) requires respondents to estimate a range around an average value for a particular object or event and taps the extent to which people use broad versus narrow ranges in estimating breadth. Such an estimate in broad versus narrow terms may be guided by motivational as well as cognitive factors. However, a further understanding of categorizing behavior may require the isolation of the antecedents of broad versus narrow

categorization.

Second, it should also be noted that differences may exist between the various tasks that have been used to measure categorizing behavior. Kogan (1976) points out that differences exist between bandwith tasks and object sorting tasks and also within the various types of bandwith tasks. For example, the sorting task where a dimension is pre-specified, involves the division or categorization of a continuum into several distinct categories wherein broad versus narrow categories may be related to the number of categories used, as suggested by Block et al. (1981). Such a task allows for subjects to categorize or divide a continuum in any way they chose to. However, the category width scale (Pettigrew, 1958) focuses on estimates of extreme points around a category and is similar in this respect to other categorization tasks which require subjects to include or exclude objects from a focal category. Further, the category width scale relates to quantitative estimates (Kogan, 1976) and involves judgments about facts (i.e., there is a correct answer). Hence, it is possible that antecedents of categorizing behavior may have different relationships with different outcomes (i.e. tasks) of categorization.

As mentioned earlier, two antecedents of broad categorization have been presented in the literature. Saltz and Sigel (1967) suggested that broad categorization is the result of the use of higher level conceptual links in making similarity judgments. A second reason for broad categorization suggested by Block et al. (1981) is "the failure to make fine-grained perceptual/conceptual distinctions among objects with minimal featural differences because of looser standards employed for assessing similarity or because of a style that minimizes such differences." (p. 778). The focus of this paper is on defining and validating a construct that captures the notion of a style that has proclivity toward using fine-grained information and engaging in fine-grained thinking.

Development of a Measure of Need for Precision

"Need for precision" is defined as *a tendency to engage in a relatively fine-grained mode of processing* .[1] This construct captures the extent to which individuals use relatively fine-grained information as well as the extent to which individuals engage in thinking involving fine-grained as opposed to coarse-grained distinctions. This construct captures a tendency to make perceptual as well as conceptual distinction among objects as suggested by Block et al. (1981). The construct taps cognitive rather than motivational aspects of processing of information. Further, in comparison with the category width scale, the focus here is on a cognitive style or preference whereas the category width scale measures an outcome of categorizing behavior, i.e., category width, which may be influenced by motivational as well as cognitive factors. Therefore, factors such as sensation seeking and openness to novel ideas do not necessarily have to be related to need for precision. However, need for precision may be related to constructs such as tolerance for ambiguity (Norton 1975) which involves precise information to the extent that a cognitive style preferring fine-grained thinking is related to a psychological discomfort with coarse-grained or imprecise (i.e., ambiguous) information.

As mentioned earlier, the importance of 'need for precision' will be demonstrated in terms of its relationship to constructs in areas other than categorizing behavior. A preference for the use of information of varying degrees of precision as well as a tendency to engage in thinking involving fine-grained versus coarse-grained distinctions may relate to constructs in domains involving numerical information such as mathematics and statistics. Researchers have pointed out that numerical information is characterized by the conveyance of relatively precise information (which allows for precise computations) when compared to other forms of information such as verbal labels (cf., Viswanathan and Childers, 1992; Beyth-Marom, 1982). Assigning numbers to events or objects provides a relatively exact rather than ambiguous way of representing information. Therefore, preference for domains involving numerical information may be related to

a basic preference for fine-grained processing.

Item Generation

Items for the NFP scale were generated in line with the operationalization of the definition of the construct. The substantive domain (i.e., precision or fine-grainedness) was operationalized by using several different phrases that denote differing degrees of fine-grainedness such as precise, vague, exact, approximate, in the ballpark, etc. Proclivity for fine-grained processing was operationalized by generating several aspects of proclivity such as enjoyment of fine-grained thinking/information (e.g., "I enjoy tasks that require me to be exact"), perceived need (e.g., "I think it is necessary to consider precise information when making a decision"), satisfaction (e.g., "I am satisfied with information as long as it is more or less close to the facts"), liking (e.g., I like to use the precise information that is available to make decisions), preference for expression (e.g., "I like to express myself precisely even when it is not necessary"), usefulness (e.g., I think approximate information is acceptable whereas exact information is not necessary), and level of interest (e.g., "I do not find it interesting to learn precise information"). Both preference for using fine-grained information (e.g., I like to use the precise information that is available to make decisions) and preference for making fine-grained distinctions (e.g., "I enjoy tasks that require me to be exact") were captured by the items.

A pool of items were generated in line with the operationalization described above and were in the form of statements that could be agreed or disagreed with to varying degrees. A total of twenty items were chosen from this pool. These items were worded such that an equal number of items were positively or negatively worded with respect to need for precision. The response format was a 7-point scale numbered from 1 to 7. The scale was labeled at the extremes as Strongly agree-Strongly disagree since responses involved degrees of agreement or disagreement with statements.

Several studies were conducted to assess the internal consistency and dimensionality of

versions of the 20 item need for precision (i.e., NFP) scale with the final aim of developing a reliable, unidimensional measure. The premise here, based on the definition of the construct, was that need for precision was a construct of a single dimension on which individuals differed. Three studies assessed the 20 item scale with a view to investigating the performance of items of the scale across studies. Based on these studies, four items were replaced with new items to form a modified scale that was assessed in Study 4. Three more studied were conducted to assess the validity of the NFP scale and its relationship to several constructs.

Study 1

88 students enrolled in undergraduate courses offered by either the business administration or the advertising departments at a midwestern university completed the 20 item NFP scale. The data was analyzed by using reliability and factor analysis procedures. The coefficient alpha for the 20 item scale was 0.86. The average inter-item correlation was 0.24 which was within the range of 0.2 to 0.4 suggested by Briggs and Cheeks (1986). Items were assessed by computing item-to-total correlations. One item had a low item-to-total correlation (Item 7 which had an item-to-total correlation of 0.18). The item-to-total correlations for the remaining 19 items ranged from 0.33 to 0.61 (see Table 1 for means, standard deviations, and item-to-total correlations).

Insert Table 1 about here

Factor analysis was performed on the 20 item scale to assess its dimensionality. A common factor analysis on the 20 item scale led to the extraction of six factors. The first three factors had eigen values greater than 1 and explained 23.7%, 8.5%, and 5.2% of the variance respectively (Eigen values were 4.73, 1.71, and 1.04 respectively). A scree test suggested the existence of a general factor. Sixteen items had their highest loadings on the first factor (see Table 2 for items and their loadings on the first factor). Four items had their highest loadings on some

other factor (Items 3, 7, 10, and 16). Three of these items (Items 3, 7, and 16) had relatively low item-to-total correlations (i.e., less than 0.35). Item 10 had a loading of 0.54 on the first factor and a loading of 0.61 on a secondary factor (with this secondary factor having an eigen value = 0.65 and explained variance = 3.2%). Additionally, item 19 had a relatively low loading (of 0.38) with the first factor and a comparable loading (of 0.31) on a secondary factor. Based on this study, it appeared that most of the items generated were forming a reliable scale and tapping a general factor. Additional studies were conducted to assess the scale and identify items that were to be replaced.

Insert Table 2 about here

Study 2

159 students enrolled in undergraduate courses offered by the department of business administration at a midwestern university completed the 20 item scale of need for precision. Coefficient alpha for the 20 item scale was 0.84. The average inter-item correlation was 0.20 which was within the range suggested by Briggs and Cheeks (1986). Three items had item-to-total correlations lower than 0.30 (Items 2,3, and 7, with correlations of 0.20, 0.23, and 0.28, respectively) (see Table 1). A common factor analysis led to the extraction of six factors with the first factor accounting for 20.9% of the variance (Eigenvalue = 4.17). Only one other factor had an eigen value greater than one (E = 1.57; %. of variance explained = 7.9%). Four items had higher loadings with other factors (Item 2, 3, 7, and 15). The other sixteen items had their highest loadings on the first factor, ranging from 0.38 to 0.60 (see Table 2).

Study 3

90 students enrolled in undergraduate courses offered by the business administration

department at a midwestern university completed the need for precision scale. A coefficient alpha of 0.88 was obtained for the 20 item scale. The average inter-item correlation was 0.27. Two items had item-to-total correlations below 0.30 (Items 3 and 7; see Table 1). A common factor analysis led to the extraction of six factors with the first factor explaining 30.3% of the variance (Eigenvalue = 6.06). Only one other factor had an eigen value greater than 1 (Eigen value = 1.55; Explained variance = 7.8%). Two items had higher loadings on secondary factors (Items 3 and 7; see Table 2). Other items had their highest loadings on the first factor which ranged from 0.40 to 0.70.

These studies suggested that most of the items were combining to form a scale that appeared to be reliable and tapping a general factor. An examination of means, standard deviations, and correlations to total of items suggests that comparable values were obtained across the three studies. The factor structure appears similar across the three studies in terms of the eigen values of extracted factors (Eigen values of the first factor were 4.73, 4.17, and 6.06 and eigen values of the second factor were 1.71, 1.57, and 1.55, in Study 1, Study 2, & Study 3, respectively). The loadings of items on the first factor were also comparable with a moderate level of variation across studies.

Based on these analyses, two items that performed poorly across Study 1, Study 2, and Study 3 were deleted (i.e., Items 3 and 7). Two other items that performed poorly in Study 1 were also deleted (Items 16 and 19) based on the average size of their loadings on the first factor and their correlations with the total scale across studies. These items were replaced with new items to form a modified scale of NFP.[2] The other items that performed poorly in any one study were retained and assessed. The resulting scale consisted of 16 items that had performed well across several studies in terms of reliability and unidimensionality. Four new items were added to the scale resulting in a modified 20 item scale. This modified 20 item scale was evaluated in the

following study.

Study 4

181 students enrolled in undergraduate courses offered by either the business administration or the advertising departments at a midwestern university completed the modified NFP scale. Coefficient alpha for the 20 item scale was 0.89 with item-to-total correlations ranging from 0.38 to 0.61 (see Table 3 for item means, standard deviations, and item-to-total correlations). The average inter-item correlation was 0.29. A common factor analysis led to the extraction of five factors with a scree test suggesting the existence of a dominant first factor (Eigen value = 6.10; Explained variance = 30.6%). Only one other factor had an eigen value greater than 1 (Eigen value = 1.55; Explained variance = 7.8%). All the items had their highest loadings on the first factor with loadings ranging from 0.42 to 0.67 (see Table 3).

Insert Table 3 about here

The NFP scale was evaluated by relating it to several constructs in an effort to assess its nomological validity and to understand the nature of its relationship to other variables. Several studies examined these relationships and are detailed below. In Study 5, the relationship between need for precision and categorizing behavior was assessed using a sorting task in order to examine the validity of the NFP scale. In Study 6, the relationship between NFP and social desirability, Need for Cognition, ACT scores, and gender were assessed. In Study 7, the relationship between NFP and (i) several constructs of categorizing behavior or relating to categorizing behavior, (ii) constructs relating to domains involving precise information such as numerical information, and (iii) ACT scores and gender were assessed.

Study 5

This study used a sorting task where subjects were required to sort several products in a product category on the basis of a single specified attribute. The sorting task has been used in past research to assess breadth of categorization (cf., Block et al., 1981). Typically, subjects have been instructed to sort objects into groups that "go together" (Block et al., 1981; p.771) based on certain dimensions (e.g., Gardner and Schoen (1962)) or on categories provided by subjects, with the number of sorted categories being used as an indicator of conceptual differentiation. Researchers have suggested that the number of sorted categories may have a negative relationship with breadth of categorization (Block et. al, 1981). A similar approach was adopted here wherein a particular dimension was specified and subjects were required to sort 12 products/brands belonging to a category (such as various beverages) into groups along that specified dimension.

Forty students at a midwestern university completed four sorting tasks and filled out the NFP scale. The sorting task required subjects to sort a set of objects into groups on the basis of specified dimensions. Subjects completed four such sortings for different object-dimension combinations. Each sorting consisted of 12 objects (such as 12 beverages that were sorted on the basis of the dimension 'sweetness'). The instructions provided to subjects followed past research in that they were asked to sort the objects in any way they chose (Block et al., 1981). Subjects were required to write down the names of objects belonging to sorted categories and to draw a circle around each set of names to indicate a category.[3]

A four item scale was created such that the response to each item was the number of groups that subjects sorted objects into (Coefficient alpha = 0.77 for the 4 item scale). A positive correlation was anticipated between NFP and the number of sortings since a proclivity for precision would suggest that a group of objects is divided more finely (i.e., into more categories). In other words, individuals with high need for precision will discriminate along a continuum more finely than individuals who have low need for precision. A significant positive correlation was

obtained between NFP and sortings ($r = 0.35$; $p < .05$), thereby providing some evidence of the validity of the need for precision in tapping preference for fine-grained processing.

Study 6

The relationship between the NFP scale and the social desirability scale was assessed to examine whether responses to items indicating a higher (or lower) preference for precision may be partially explained by social desirability. A possible explanation for such a reaction may be based on a perception that it is more socially desirable to indicate greater preference for precise information on the assumption that precision is related to accuracy.

Need for Cognition (Cacioppo and Petty, 1982) is the "tendency of an individual to engage in and enjoy thinking" (p. 116). To the extent that NFP relates to a proclivity toward more precision in thinking, it could be argued that such a need may be associated with a Need for Cognition. This is because a need for greater precision may covary with a tendency to engage in thinking on the premise that making finer distinctions requires more thinking. Evidence for the greater effort involved in making finer distinctions is available from the literature on comparative judgments (cf., Banks, 1977). A robust finding in this literature, referred to as the symbolic distance effect, is that there is a decrease in accuracy and/or an increase in response time as the discrimination between pairs of stimuli become finer (i.e., as the 'distance' between a pair of stimuli being compared decreases). Researchers have presented explanations for this finding which suggest that greater effort may be involved in making finer discriminations (cf., Banks, 1977).

Method

61 subjects completed the modified NFP scale and several other scales including 33 items social desirability scale (Crowne and Marlowe), and a shortened version of the Need for Cognition scale comprising of 18 items (Cacioppo, Petty, & Kao, 1984). Self-reports of ACT scores and gender were also collected. Items on the NFP scale, Need for Cognition scale, and social

desirability scale were scored such that higher ratings indicated higher need for precision, higher Need for Cognition, and higher social desirability, respectively.

Results

The data was analyzed by computing the mean value across all items of each scale for each respondent.[4] NFP had a nonsignificant correlation with the 33 item social desirability scale (r = 0.01).[5] Therefore, it appears that social desirability is not a significant factor in explaining responses to items on the NFP scale, with the results providing some evidence of discriminant validity. NFP had a positive correlation with Need for Cognition (r = 0.25; $p < .05$). The size of the correlation suggests that there is a significant but small relationship between NFP and Need for Cognition. Therefore, it appears that a tendency to enjoy thinking per se is not strongly related to a tendency to enjoy thinking based on precise information. However, the significant correlation provides some evidence for the claim that the NFP scale taps proclivity toward fine-graned thinking, which is argued to require more effort, and therefore, would relate to a tendency to engage in more thinking in general.

Comparison of differences in NFP score based on gender suggested that females scored higher than males (Mean NFP scores of 4.62 versus 4.44 for females (n=41) versus males (n=20) with the difference being non-significant (t (58) = 0.64). This result is directionally consistent with the results of studies in past research that males tended to be broad categorizers when compared to females (Block et al., 1981; Pettigrew, 1958). An examination of 'high' versus 'low' NFP scores (with a split made on the mean NFP score) was performed to investigate possible differences in ACT scores. The results suggested a directional but non-significant effect such that individuals with higher NFP scores tended to have report higher ACT scores (Mean ACT scores of 28.52 versus 26.84 for the high NFP group (n=25) versus the low NFP group (n=26) (t (49) = 0.66). Again, these results are directionally consistent with past studies which have found that

broad categorizers tend to score lower on IQ tests (Block et. al., 1981) and on quantitative ability (Pettigrew, 1958) to the extent that ACT scores can be used as a proxy for IQ tests and tests of quantitative ability.

Study 7

The relationship between NFP and (i) several constructs of categorizing behavior or relating to categorizing behavior, (ii) constructs relating to domains involving precise information such as numerical information, and (iii) ACT scores and gender were assessed in Study 7.

Relationship with Constructs relating to Categorizing behavior

In an effort to further understand the relationship of the NFP scale with other constructs and provide evidence of its validity, the relationship of NFP with category width (Pettigrew, 1958), tolerance for ambiguity (Norton, 1975) and several other constructs that have been studied in the context of category width (i.e., sensation seeking and dogmatism were examined). As discussed earlier, researchers have pointed out possible relationships between openness to experience and breadth of categorization. Therefore, innovativeness (which is defined as openness to change; Hurt, Joseph, & Cook, (1977)) was also studied here. Opinion leadership, which has been defined as personal influence among consumers in the context of adopting innovations (Childers, 1986), was also studied here since opinion leaders were expected to be open to new ideas and innovations.

Norton (1975) defined intolerance for ambiguity as a tendency to perceive ambiguous information as "sources of psychological discomfort or threat". He further points out that the term ambiguity is used to mean several things which he categorizes into several groups which include the use of ambiguity to mean being unclear, having uncertainty, having multiple meanings, the lack of information, vagueness, etc. Several of these categories relate to fine-grained versus coarse-grained information in that coarse-grained information may be subject to multiple meanings, be

relatively vague, be unclear, have some uncertainty since the exact value is not available, be perceived as lack of information, etc. Norton (1975) points out that ambiguity may relate to the variability in possible interpretations. Since coarse-grained when compared to fine-grained information is less finely distinguished from other possible values, such information is subject to greater variability in interpretations. If such variability is perceived as a source of threat or discomfort, a low tolerance for ambiguity is indicated. To the extent that a cognitive style that reflects proclivity toward fine-grained information is related to the perception of ambiguous information as a source of threat or discomfort, a relationship between NFP and tolerance for ambiguity may be found.

However, such a linkage does not follow for constructs such as sensation seeking or openness to novel ideas since the focus is not on the level of inclusion as in category width, but on preference for fine-grained versus coarse-grained information, a cognitive antecedent of categorizing behavior. This is an important distinction, given the domain of NFP. A cognitive preference for fine-grained thinking may not be related to constructs tapping openness to experience (i.e., a cognitive style of making fine-grained distinctions may co-occur with openness as well as lack of openness to experience). Similarly, no relationship with dogmatism is expected since a need to make fine-grained distinctions may be independent of a need to adhere to a previous position. In contrast, given arguments made in the past regarding category width, a positive relationship would be expected between category width and sensation seeking, innovativeness, and opinion leadership, on the premise that broad categorizers would be more likely to be inclusive and open to experiences and ideas. It should be noted, though, that past research has not led to consistent findings about a linear relationship between category width and sensation seeking. A relationship between category width and dogmatism is not expected, in line with results from past research.

Relationship with Constructs involving Precise Information

As mentioned earlier, researchers have pointed out that numerical information is characterized by the conveyance of relatively precise information (which allows for precise computations) when compared to other forms of information such as verbal labels (cf., Viswanathan and Childers, 1992; Beyth-Marom, 1982). Therefore, another set of constructs that were examined related to domains involving numerical information to understand the role of need for precision in attitude toward such domains as statistics and mathematics.

Viswanathan (1992) developed a scale that measures preference for using numerical information and engaging in thinking based on numerical information. A positive correlation would be expected between NFP and this scale, given the precise nature of numerical information. Wise (1985) developed a scale that measures attitudes toward statistics to measure change in attitude among students of introductory statistics. The 29 item scale is argued to have two sub-scales: attitudes of students toward the course and attitudes of students toward the field of statistics. Aiken (1974) developed two scales of attitude toward mathematics referred to as enjoyment of mathematics and value of mathematics. Given the numerical content in statistics and mathematics, a positive correlation would be expected between need for precision and attitude toward statistics and mathematics scales.

The relationship between NFP and preference for visual and/or verbal processing was assessed by studying the construct, style of processing (Childers, 1985). The measure of style of processing contains two sets of items relating to visual processing (e.g., My thinking often consists of mental "pictures" and images) and verbal processing (e.g., I do a lot of reading). On the premise that visual information typically involves a high degree of precision in a pictorial form, a positive correlation was expected between NFP and the style of processing scale (where a high degree of visual processing and a low degree of verbal processing would lead to a high score on the style of processing scale).

Method

174 students at a midwestern university completed several scales including the NFP scale[6], the 20 item category width scale (Pettigrew, 1958), the 29 item attitude to statistics scale consisting of two subscales (Wise, 1985) the two scales of attitude toward mathematics (Aiken, 1974), the 22 item sensation seeking scale (Zuckerman et al., 1964), a modified form of the 7 item opinion leadership scale (Childers, 1986), the innovativeness scale (Hurt et al., 1977), the dogmatism scale (Rokeach, 1956), the style of processing scale (Childers et al., 1985), and a shortened version of the tolerance for ambiguity scale (Norton, 1975).[7] Self-reports of ACT scores and gender were also collected.

Results

Relationship with Constructs relating to Categorizing behavior

Correlations between NFP and several constructs were computed across respondents based on mean scores on each scale.[8] The NFP scale had a weak negative correlation with the category width scale (r = -0.13), a significant negative correlation with tolerance for ambiguity (r = -0.29; $p < .01$), a weak negative relationship with the sensation seeking scale (r = -0.11) and non-significant correlations with innovativeness, opinion leadership, and dogmatism (see Table 4). These results are consistent with the argument made earlier that NFP reflects a cognitive style that may correlate significantly with tolerance for ambiguity but is not necessarily related to constructs such as sensations seeking and innovativeness. Category width also had weak correlations with these constructs. Perhaps, the nature of the category width task in relating to the estimation of a range around an average value wherein factual data is available, does not necessitate openness to experiences (i.e, wide ranging possibilities) in order to estimate broad rather than narrow categories. The relationship between category width and constructs such as sensation seeking is not clear, as suggested by several researchers.

Insert Table 4 about here

Interestingly, tolerance for ambiguity had significant correlations with sensation seeking, innovativeness, and dogmatism and a positive correlation with opinion leadership (see Table 4) with several intercorrelations between these constructs being significant. These results suggest that tolerance for ambiguity is related positively to openness to change (i.e., innovativeness), a tendency to seek a variety of experiences (i.e., sensation-seeking), and opinion leadership. Further, tolerance for ambiguity is negatively related to dogmatism. Hence, a perception of threat or psychological discomfort with ambituity appears to be an important variable in understanding the relationships between constructs suchas sensation seeking and innovativeness.

The sample was divided into two groups based on the overall mean NFP score (these two groups are referred to as 'high' versus 'low' NFPs) and differences between these two groups for several constructs were also assessed. Low NFPs had a significantly higher score on category width than high NFPs (3.26 versus 2.91 for low versus high NFPs; t (158) = 2.60; $p < .001$). Low NFPs had a higher score on sensation seeking than high NFPs but the difference was non-significant (1.52 versus 1.49 for low versus high NFPs; t (158)= 1.35). Low NFPs had a significantly higher score on tolerance for ambiguity than high NFPs (2.61 versus 2.34 for low versus high NFPs; t (158) = 2.53; $p < .001$). Low NFPs had a higher score on opinion leadership than high NFPs but the difference was non-significant (3.71 versus 3.56 for low versus high NFPs; t (157)= 1.64). Low NFPs had a higher score on innovativeness than high NFPs but the difference was non-significant (3.44 versus 3.24 for low versus high NFPs; t (158)= 1.35). No significant differences were obtained for the dogmatism scale.

Correlations with Constructs involving Precise Information

The need for precision scale was positively correlated to preference for numerical information (r = 0.41; $p < .01$). NFP was also related to Attitude to Mathematics (r = 0.28; $p < .01$) and Attitude to Statistics (r = -0.27; $p < .01$) (see Table 5). These results suggest the possible

role of need for precision in influencing constructs in domains involving numerical information.[9] A positive correlation was obtained with style of processing ($r = 0.23$; $p < .05$). Again, this result is consistent with the argument made earlier that constructs involving precise information (such as visual processing) would be related to a cognitive style that captures a tendency toward fine-grained processing. (It should be noted that category width did not correlate significantly with any of these measures.)

Insert Table 5 about here

No significant differences in ACT scores were obtained across low versus high NFPs. Comparison of differences in NFP score based on gender suggested that females scored significantly higher than males (Mean NFP scores of 4.77 versus 4.48 for females (n=94) versus males (n=65); (t (157) = 2.46; $p < .001$). This result is directionally consistent with the results of studies in past research that males tended to be broad categorizers when compared to females (Block et al., 1981; Pettigrew, 1958).

Discussion

Need for precision, a tendency toward fine-grained processing was argued to be a construct of importance to several areas of research including categorizing behavior and domains involving quantitative information. Need for precision was defined as a tendency to engage in a relatively fine-grained mode of processing. Items were generated in line with this definition. Twenty items were chosen from a larger pool and assessed across three studies. High coefficient alphas were obtained across three studies. Most of the items performed well across the three studies in terms of item-to-total correlations. Factor analyses suggested the existence of a dominant first factor. Most of the items performed well across three studies in terms of their loadings on the dominant factor.

Based on these three studies, it appeared that most of the items combined to form a reliable scale that was tapping a unidimensional construct. The items that performed poorly were replaced with new items and the modified scale was assessed in another study. All the items performed well in this study in terms of internal consistency and unidimensionality.

Several lines of evidence were provided for the validity of the PNI scale. In line with predictions, NFP was found to be positively related to the number of categories employed in a sorting task, thereby providing evidence of the validity of the measure. NFP was not related to social desirability. NFP was positively related to Need for Cognition, a finding that was argued on the basis of greater effort being required to make finer distinctions. In line with arguments that both constructs relate to the precision of information, a negative relationship was found between NFP and tolerance for ambiguity. A weak negative relationship was found with category width, a result that only provides directional support for the hypothesized prediction. Finally, positive relationships were found between need for precision and constructs involving precise information such as preference for numerical information, and preference for visual processing, thereby providing another line of evidence for the validity of the NFP measure.

The nature of inter-relationships among constructs such as NFP, category width, tolerance for ambiguity, and sensation seeking provide new insights. While NFP was related to tolerance for ambiguity and to category width, it did not have significant relationships with constructs such as sensation seeking and innovativeness. Similarly, category width did not have significant relationships with these constructs. To the extent that NFP and category width can be argued to be in the realm of cognition, the only relationship found with constructs involving motivational aspects was the relationship between NFP and tolerance for ambiguity, in line with arguments made earlier about the overlap across these two constructs in terms of precise information. However, tolerance for ambiguity appeared to be related to several of these constructs, thereby suggesting that the perception of ambiguity as a threat or a source of psychological discomfort may

be an important factor in understanding openness to change and openness to experiences. In line with some studies in past research, category width was not found to relate to these constructs. In fact, NFP had a weak relationship with category width but a strong relationship to the number of categories employed using a sorting task. Therefore, the nature of the category width scale in terms of its relationship to other constructs is not clear, as suggested by several researchers.

Several interesting conclusions can be drawn about the relationship between NFP and other constructs involving precise information. As discussed earlier, NFP appears to play an important role in domains involving numerical information such as statistics and mathematics. A tendency for fine-grained thinking may be an important causal factor in determining attitude and ability in quantitative domains (which involve precise computations and relatively explicit and precise analysis). NFP was also related to a tendency toward visual processing, another important dimension on which individuals differ in terms of processing. NFP had a positive relationship with Need for Cognition, thereby suggesting that a higher tendency to engage in thinking is related to a tendency toward fine-grained processing. Therefore, NFP appears to be a construct that relates to several important aspects of thinking.

In conclusion, need for precision, a construct tapping a tendency toward fine-grained processing was defined and a scale measuring this construct was developed and assessed for reliability and validity. Several interesting relationships between this construct and constructs relating to categorizing behavior, and constructs involving precise information were found. The construct, need for precision, appears to be captured by a reliable, valid scale and appears to have relationships with several constructs that provide promising avenues of future research.

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Footnotes

[1] The terms "coarse-grained" and "fine-grained" refer to how finely distinguished the values on a continuum are from other possible values. A scale that is sensitive to 1 cm is more fine-grained than a scale that is sensitive to 1 inch, since a 1 cm interval is a finer increment than a 1 inch interval. These terms are used in a relative sense and do not convey any absolute level of "grainedness." The degree of fine-grainedness may apply to perceptual as well as conceptual processing. Further, the terms can apply to distinctions along a specific dimension as well as distinctions based on multiple dimensions.

[2] Items 3 and 7 performed poorly across all three studies and were, therefore, deleted. Item 3 may be tapping domains other than precision such as memory required to "reconstruct information" (see Table 2). Item 7 may suffer from several problems including the use of the phrase "*stop thinking* when I have a rough idea of my views" which may not necessarily follow from the definition of need for precision. Items 16 and 19 were replaced based on their performance on Study 1 and relatively mediocre performance in the other studies.

[3] The procedure was pilot tested and written protocols self-reports were elicited which suggested that subjects were adhering to instructions. The sorting task was assessed by examining response of subjects to several scales. Subjects' confidence, knowledge, experience, motivation and ease in performing the sorting task were assessed after each sorting. Further, the extent to which subjects performed the sorting based on the one specified dimension was also assessed since adherence to this was central to the purpose of the sorting. The sorting task was also assessed by treating each of the four sortings performed as an item in a multiple item scale. A four item scale was, therefore, created such that the response to each item was the number of groups that subjects sorted objects into. Moderate intercorrelations between these items (average intercorrelation = 0.46) and a moderate reliability (Coefficient alpha = 0.77) for the four item scale

point to the existence of individual differences in sorting which is tapped by the sorting task. Such differences between individuals is expected in light of past research in psychology using sorting tasks to assess individual differences in breadth of categorization (cf., Block et al. 1981).

4 The reliability of the Need for Cognition scale was 0.86. The reliability of the 33 item social desirability scale was 0.60. (Deletion of 5 items from the scale with negative item-to-total correlations led to a reliability of 0.66.)

5 NFP also had a non-significant correlation with the more reliable 28 item social desirability scale (r = -0.03).

6 This study employed the original NFP scale since it was conducted in conjuncton with the data collection reported in Study 2. Therefore, data analysis was based on the 16 items that were chosen for the final, modified NFP scale.

7 Childers (1986) presented a 7 item scale of opinion leadership in the context of cable televisions (with the sample consisting of cable subscribers and 'refusers'). This scale was modified mainly by replacing the term "cable television" with the term "various issues". Therefore, opinion leadership in the context of issues in general was assessed. Norton (1975) presents 61 items of ambiguity tolerance relating to several domains such as philosophy, public image, etc. Fourteen items were chosen from the pool such that the various domains (seven in all) were represented in approximate proportion to the total number of items in each domain presented by the author.

8 Coefficient alphas of the various scales were assessed and are indicated in parenthesis for each scale; the category width scale (0.85), the sensation seeking scale (0.75), the tolerance for ambiguity scale (0.71), the innovativeness scale (0.79), the opinion leadership scale (0.67), the dogmatism scale (0.71), , the total math scale (0.90), the total attitude to statistics scale (0.91),the

preference for numerical information scale (0.91), and the style of processing scale (0.66), .

[9] 108 students who were enrolled in undergraduate courses offered by the engineering department at a midwestern university completed the NFP scale. This was with a view to assess differences between students enrolled in engineering courses (typically high quantitative content) with students enrolled in courses offered by the business administration and advertising departments (low quantitative content in comparison). Coefficient alpha for the NFP scale was 0.82 with two items having item-to-total correlations below 0.3 (Item 3 and Item 7). The average inter-item correlation was 0.19. The mean value on the NFP scale was computed using the 16 items that performed well on the first three studies since the original NFP scale was employed for this study. A mean of 4.61 was obtained for this study which was significantly different than the mean in Study 1 (Mean = 4.32) but not in Study 2, and Study 3 (Mean = 4.65, & 4.51). The standard deviations for the scale in this study were also consistently lower than the standard deviations in other studies (Mean standard deviation = 0.66 versus 0.78, 0.73, and 0.85 in Study 1, Study 2, and Study 3).

Table 1

Item Statistics for Study 1, Study 2, & Study 3

	Study 1			Study 2			Study 3		
Item	Mean	SD	ITT	Mean	SD	ITT	Mean	SD	ITT
1	4.08	1.66	0.48	5.10	1.38	0.49	4.55	1.43	0.53
2	5.50	1.41	0.37	5.46	1.35	0.20	5.54	1.20	0.38
3	4.34	1.49	0.33	4.90	1.41	0.23	4.93	1.49	0.16
4	4.44	1.50	0.53	4.94	1.53	0.55	4.57	1.47	0.60
5	5.18	1.23	0.55	5.36	1.32	0.56	5.01	1.39	0.65
6	4.09	1.34	0.47	4.43	1.30	0.43	4.25	1.40	0.51
7	4.60	1.54	0.17	4.71	1.39	0.28	4.64	1.69	0.28
8	4.68	1.50	0.49	5.19	1.34	0.49	5.11	1.41	0.39
9	3.91	1.50	0.48	4.07	1.57	0.47	4.52	1.43	0.53
10	3.93	1.25	0.53	4.05	1.29	0.40	4.22	1.51	0.52
11	4.67	1.30	0.61	4.75	1.38	0.44	4.69	1.58	0.49
12	3.73	1.59	0.39	4.01	1.64	0.42	3.92	1.71	0.45
13	3.88	1.46	0.45	4.62	1.46	0.34	3.98	1.62	0.49
14	4.27	1.44	0.55	4.70	1.30	0.43	4.63	1.28	0.50
15	4.26	1.38	0.42	4.38	1.46	0.32	4.41	1.60	0.57
16	4.25	1.45	0.34	4.37	1.29	0.38	4.11	1.41	0.38
17	3.73	1.35	0.57	3.79	1.33	0.43	3.73	1.53	0.60
18	4.32	1.37	0.53	4.66	1.37	0.42	4.45	1.51	0.66
19	4.74	1.31	0.34	4.77	1.30	0.35	4.81	1.42	0.51
20	5.30	1.23	0.48	5.57	1.21	0.56	5.39	1.14	0.62

Note. SD = Standard deviation of item; ITT = Item to total correlation.

Table 2

Item Loadings on First Factor for Study 1, Study 2, & Study 3

		Study 1	Study 2	Study 3
1.	I enjoy tasks that require me to be exact.	0.50	0.52	0.56
2.	Vague descriptions leave me with the need for more information.	0.43	0.11*	0.41
3.	I reconstruct information in my mind just the way I learned it.	0.36*	0.18*	0.21*
4.	I am stickler for details.	0.55	0.53	0.67
5.	I think it is necessary to consider precise information when making a decision.	0.61	0.54	0.70
6.	I am very discerning even when it comes to subtle differences.	0.49	0.39	0.60
7.	I usually stop thinking when I have a rough idea of my views on an issue.	0.19*	0.20*	0.31*
8.	I do not find it interesting to learn precise information.	0.49	0.60	0.40
9.	Thinking is enjoyable when it does not involve exact information.	0.53	0.60	0.55
10.	I tend to put things into broad categories as much as possible.	0.54*	0.51	0.56
11.	I dont see the point in trying to discriminate between slightly different alternatives.	0.52	0.47	0.54
12.	I try to be only as exact as I need to be.	0.38	0.53	0.46
13.	I like to express myself precisely even when it is not necessary.	0.41	0.36	0.55
14.	I think approximate information is acceptable whereas exact information is not necessary.	0.55	0.48	0.56
15.	I am satisfied with information as long as it is more or less close to the facts.	0.47	0.37*	0.61
16.	I enjoy thinking about issues which involve making fine distinctions.	0.41*	0.44	0.41
17.	I find it easier to express my opinions in approximate rather than exact terms.	0.62	0.48	0.65
18.	I am satisfied with my knowledge about issues as long as I am in the ballpark.	0.58	0.51	0.70
19.	I find approximate information to be misleading whereas exact information is dependable.	0.38	0.39	0.57
20.	I like to use the precise information that is available to make decisions.	0.51	0.52	0.67

Note. * = Equal or higher loadings on secondary factors

Table 3

Item Statistics and Loadings on First Factor for Study 4

		Mean	S.D.	ITT	Loading
1.	I enjoy tasks that require me to be exact.	4.59	1.59	0.61	0.65
2.	Vague descriptions leave me with the need for more information.	5.65	1.16	0.38	0.42
3.	I like to know precisely what is meant by information that I learn.*	5.47	1.18	0.53	0.61
4.	I am stickler for details.	4.82	1.58	0.62	0.67
5.	I think it is necessary to consider precise information when making a decision.	5.40	1.36	0.54	0.59
6.	I am very discerning even when it comes to subtle differences.	4.49	1.43	0.51	0.55
7.	I have a rough rather than exact idea of my opinions on various issues.*	4.11	1.65	0.48	0.51
8.	I do not find it interesting to learn precise information.	5.00	1.45	0.59	0.62
9.	Thinking is enjoyable when it does not involve exact information.	4.10	1.52	0.41	0.44
10.	I tend to put things into broad categories as much as possible.	4.18	1.44	0.57	0.61
11.	I dont see the point in trying to discriminate between slightly different alternatives.	4.75	1.42	0.60	0.63
12.	I try to be only as exact as I need to be.	3.87	1.56	0.52	0.56
13.	I like to express myself precisely even when it is not necessary.	4.19	1.62	0.42	0.44
14.	I think approximate information is acceptable whereas exact information is not necessary.	4.58	1.61	0.50	0.53
15.	I am satisfied with information as long as it is more or less close to the facts.	4.33	1.47	0.47	0.50
16.	Even slight differences in opinion are of importance to me.*	4.63	1.37	0.47	0.51
17.	I find it easier to express my opinions in approximate rather than exact terms.	3.70	1.52	0.59	0.63
18.	I am satisfied with my knowledge about issues as long as I am in the ballpark.	4.56	1.40	0.47	0.50
19.	I like tasks which require me to look for small differences between things.*	4.11	1.44	0.46	0.51
20.	I like to use the precise information that is available to make decisions.	5.14	1.28	0.45	0.48

Note. * = New items that replaced items that performed poorly in the first three studies.

Table 4

Correlations between NFP and Constructs relating to Categorizing behavior

	NFP	CW	AMB	DOG	SEN	INN
CW	-0.13					
AMB	-0.29**	-0.02				
DOG	0.02	-0.03	-0.35**			
SEN	-0.11	0.02	0.34**	-0.21**		
INN	0.06	-0.05	0.40**	-0.24**	-0.45**	
OL	0.11	-0.01	0.15	-0.15	0.26**	0.35**

Note. CW= Category Width scale (Pettigrew); AMB= Tolerance for ambiguity scale; DOG = Dogmatism; SEN = Sensation seeking scale; INN = Innovativeness scale; OL = Opinion leadership scale

* $p < .05$. ** $p < .01$.

Table 5

Correlations between NFP and Attitudes toward mathematics and statistics.

	NFP	CW	AMB	ATS	MTH
CW	-0.13				
AMB	-0.29**	-0.02			
ATS	0.27**	0.03	-0.08		
MTH	0.30**	0.05	-0.19*	0.69**	
PNI	0.41**	0.08	-0.24**	0.61**	0.74**

Note. CW= Category Width scale (Pettigrew); AMB= Tolerance for ambiguity scale; ATS = Attitude toward statistics scale; MTH = Attitude toward mathematics scale.

* $p < .05$. ** $p < .01$.